[This question paper contains 2 printed pages.]

Your Roll No...............

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Sr. No. of Question Paper	**:**	**5527**
Unique Paper Code	:	2374000024
Name of the Paper	:	Introduction to Reliability Theory
Name of the Course	:	**B.A. (P) / B.Sc. (P) / B.Sc. (H)**
Semester	:	VIII

Duration : 3 Hours — Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Question **1** is compulsory.
3. Attempt **six** questions in all.
4. Use of a non-programmable scientific calculator is allowed.

1. Attempt the following:

a) Define Hazard function and find out its relation with failure distribution function.

b) Define Reliability of a system with a suitable example.

c) Define mean inactive time (MIT)

d) If hazard rate of a component is .7 x 10^{-4}, then find MTTF.

e) Define Proportional reverse hazard rate model. (5 × 3 = 15)

2. The failure density function of the random variable T is given by

$$f(t) = 0.5\, e^{-0.5t}, \quad t \geq 0.$$

Calculate

i. Reliability of the component

ii. Reliability of the component for a 100 hours mission time

iii. Mean Time to Failure (MTTF)

iv. Median time of the random variable T

v. What is the life of the component, if the reliability of 0.96 is desired? (5 × 3 = 15)

3. **a)** Explain the concept of bathtub type failure rate. Draw the curve and discuss different phases of the hazard function.

b) Describe the maximum likelihood estimation (MLE) method for estimating the parameter of the exponential distribution for complete samples. (7,8)

P.T.O.

4. a) How do you do estimation with Censored Samples? Differentiate between failure censored and time censored samples.

b) Explain the concept of a failure-censored sample in case of exponential distribution with Probability density function:

$$f(t) = \frac{1}{\theta} e^{-\frac{t}{\theta}} \quad t > 0,\ \theta > 0.$$

Find out the mean and variance of the unknown parameter θ.

(6, 9)

5. a) The lifetime of a component is assumed to follow an exponential distribution with a mean of 5 hours. Obtain the following probabilities:
(i) The probability that the component survives beyond 10 hours.
(ii) The probability that the component fails within the first 3 hours.

b) A system consists of four independent components arranged in a 2-out-of-4 configuration in which probability of success of each component is 0.5.
(i) Find the probability that the system functions successfully.
(ii) Determine the probability that exactly two components fail. (7, 8)

6. a) Explain the role of ageing in system reliability analysis and discuss different ageing properties of lifetime distributions.

b) What is redundancy? Explain different types of redundancy in systems. (7, 8)

7. a) For a Weibull distribution with scale parameters 'α' and shape parameter 'β', write down the expression for probability density function, reliability function, and Hazard function.

b) The failure time of a certain component has a Weibull distribution with $\alpha = 2000$ and $\beta = 4$.
Find (i) Reliability function (ii) Hazard function (iii) Reliability and hazard at $t = 1500$ hours. (9, 6)